

INDIANA DEPARTMENT OF TRANSPORTATION
MATERIALS AND TESTS DIVISION

VERIFYING THERMOMETERS
ITM No. 909-98T

1.0 SCOPE

- 1.1 This test method covers the procedure for a verification of scale accuracy of liquid-in-glass total and partial immersion thermometers, dial type thermometers, and handheld digital thermometers.
- 1.2 The values stated in either SI metric or acceptable English units are to be regarded separately as standard, as appropriate for a specification with which this ITM is used. Within the text, English units are shown in parenthesis. The values stated in each system may not be exact equivalents; therefore each system shall be used independently of the other, without combining values in any way.
- 1.3 This ITM may involve hazardous materials, operations, and equipment. This ITM does not purport to address all of the safety problems associated with the ITMs use. The ITM user's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2.0 REFERENCED DOCUMENTS

- 2.1 ASTM Standards
 - E 1 Specification for ASTM Thermometers

3.0 APPARATUS

- 3.1 Certified thermometer, National Institute of Standards and Technology (NIST) traceable, and of equal or better precision than the thermometer being verified.
- 3.2 Water/oil bath, capable of maintaining a constant temperature for the time sufficient for verification.

4.0 SIGNIFICANCE AND USE

- 4.1 This ITM is used by laboratory personnel to verify the scale accuracy of liquid-in-glass total and partial immersion thermometers, dial type thermometers, and handheld digital thermometers.

5.0 PROCEDURE – LIQUID-IN-GLASS TOTAL AND PARTIAL IMMERSION

- 5.1 Record the manufacturer, serial number, type, model number, graduation, and date of calibration for the certified thermometer.
- 5.2 Record the manufacturer, serial number, type, model number, and graduation of the thermometer being verified.
- 5.3 Visually inspect the shaft of the thermometer being verified for air bubbles, separation of the liquid, foreign matter, glass faults, or any other apparent defects.
- 5.4 Immerse the thermometer being verified into a water/oil bath to the indicated immersion line for partial immersion thermometers or to the point being verified for total immersion thermometers. A water bath is used for verifications less than 95 °C (200 °F), and an oil bath is used for verifications equal to or greater than 95 °C (200 °F).
- 5.5 Immerse the certified thermometer into the bath as specified in 5.4.
- 5.6 Allow the readings on both thermometers to stabilize, and record the temperatures of the thermometers.
- 5.7 If the thermometer being verified does not indicate the same reading as the certified thermometer, yet, is within the scale error max, it may be used if the difference is visibly noted and the offset is applied during use.

6.0 PROCEDURE -- DIAL TYPE

- 6.1 Record the manufacturer, serial number, type, model number, graduation, and date of calibration for the certified thermometer.
- 6.2 Record the manufacturer, serial number, type, model number, and graduation of the thermometer being verified.
- 6.3 Immerse the dial thermometer into a container of boiling water to a depth of approximately one-half of the depth of the container.
- 6.4 Immerse the certified thermometer into the container as specified in 6.3.
- 6.5 Allow the readings on both thermometers to stabilize and record the temperatures of the thermometers.
- 6.6 If the thermometer being verified does not indicate the same reading as the certified thermometer, yet, is within the tolerance of 8.2, it may be used if the difference is visibly noted and the offset is applied during use.

7.0 PROCEDURE -- HANDHELD DIGITAL THERMOMETER

- 7.1 Record the manufacturer, serial number, type, model number, graduation, and date of calibration for the certified thermometer.
- 7.2 Record the manufacturer, serial number, type, model number, and graduation of the thermometer being verified.
- 7.3 Immerse the thermocouple assembly into a container of boiling water to a depth of approximately one-half of the depth of the container.
- 7.4 Immerse the certified thermometer into the container as specified in 7.3
- 7.5 Allow the readings on both thermometers to stabilize and record the temperature of the thermometers.
- 7.6 If the thermometer being verified does not indicate the same reading as the certified thermometer, yet, is within the tolerance of 8.3, it may be used if the difference is visibly noted and the offset is applied during use.

8.0 TOLERANCES

- 8.1 Liquid-in-glass thermometers shall agree with the certified thermometer to within the scale error max of Table 1.
- 8.2 Dial type thermometers shall be within 2.5 °C (5.0 °F).
- 8.3 Handheld digital thermometers shall be within 1 °C (2 °F).

ATTACHMENT I

TABLE 1

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Celsius Range	Scale Error max	Fahrenheit Range	Scale Error max	Celsius Range	Scale Error max	Fahrenheit Range	Scale Error max
Graduated in 0.01°C				Graduated in 0.1°C		Graduated in 0.2°F	
18.9 to 25.1°C	0.1			0 to 30°C	0.1		
23.9 to 30.1°C	0.1			19 to 27°C	0.1	66 to 80°F	0.2
Graduated in 0.02°C		Graduated in 0.05°F		20 to 50°C	0.1		
4 to 6°C	0.04			25 to 55°C	0.1	77 to 131°F	0.2
19 to 35°C	0.10	66 to 95°F	0.20	34 to 42°C	0.1	94 to 108°F	0.2
Graduated in 0.05°C		Graduated in 0.1°F		38 to 82°C	0.1	100 to 180°F	0.2
-55.4 to -52.6°C	0.1	-67.5 to -62.5°F	0.2	40 to 70°C	0.1		
-41.4 to 38.6°C	0.1	-42.5 to -37.5°F	0.2	49 to 57°C	0.1	120 to 134°F	0.2
-27.4 to 24.6°C	0.1	-17.5 to -12.5°F	0.2	50 to 80°C	0.1	122 to 176°F	0.2
-21.4 to 18.6°C	0.1			57 to 65°C	0.1	134 to 148°F	0.2
-19.4 to 16.6°C	0.1	-2.5 to +2.5°F	0.2	60 to 90°C	0.1		
-1.4 to +1.4°C	0.1	29.5 to 34.5°F	0.2	75 to 105°C	0.1	167 to 221°F	0.2
		54 to 101°F	0.2	79 to 87°C	0.1	174 to 188°F	0.2
18.6 to 21.4°C	0.1	66.5 to 71.5°F	0.2	80 to 110°C	0.1		
	0.1	69 to 116°F	0.2	95 to 103°C	0.1	204 to 218°F	0.2
23.6 to 26.4°C	0.1	74.5 to 79.5°F	0.2	100 to 130°C	0.2		
28.6 to 31.4°C	0.1	83.5 to 88.5°F	0.2	120 to 150°C	0.2		
36.6 to 39.4°C	0.1	97.5 to 102.5°F	0.2	130 to 140°C	0.2		
38.5 to 41.5°C	0.1			Graduated in 0.2°C		Graduated in 0.5°F	
48.6 to 51.4°C	0.1	119.5 to 124.5°F	0.2			-65 to +5°F	1
52.6 to 55.4°C	0.1	127.5 to 132.5°F	0.2	-50 to +5°C	0.2	-55 to +40°F	0.4
58.6 to 55.4°C	0.1	137.5 to 142.5°F	0.2	-38 to +42°C	0.2	-36.5 to 107.5°F	0.5
80.6 to 83.4°C	0.1	177.5 to 182.5°F	0.2			-35 to +35°F	0.5
91.6 to 94.4°C	0.1	197.5 to 202.5°F	0.2	-20 to +102°C	0.1	-5 to 215°F	0.25
		207.5 to 212.5°F	0.2	-2 to +52°C	0.2		
98.6 to 101.4°C	0.1			-2 to +68°C	0.2		
133.6 to 136.4°C	0.15	272.5 to 277.5°F	0.3	-2 to +80°C	0.2	30 to 180°F	0.4
				18 to 28°C	0.1		
Graduated in 0.1°C		Graduated in 0.2°F		20 to 70°C	0.2		
-51.6 to -34°C	0.1	-61 to -29°F	0.2	20 to 100.6°C	0.2	68 to 213°F	0.5
-45 to -35°C	0.4			24 to 78°C	0.2		
-38.3 to -30°C	0.2	-37 to -22°F	0.4	25 to 105°C	0.2	77 to 221°F	0.5
-38 to +2°C	0.1	-36 to +35°F	0.2	32 to 127°C	0.2	90 to 260°F	0.5
-35 to -25°C	0.4			39 to 54°C	0.1		
-25 to -15°C	0.2			48 to 102°C	0.2		
-15 to -5°C	0.2			72 to 126°C	0.2		
-20 to +10°C	0.1			90 to 170°C	0.4	194 to 338°F	4
-10 to +5°C	0.1			95 to 105°C	0.1		
				98 to 152°C	0.3		
-8 to +32°C	0.1	18 to 89°F		95 to 155°C	0.2	203 to 311°F	0.5

TABLE 1

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Celsius Range	Scale Error max	Fahrenheit Range	Scale Error max	Celsius Range	Scale Error max	Fahrenheit Range	Scale Error max
Graduated in 0.02°C		Graduated in 0.5°F		Graduated in 1°C		Graduated in 2°F	
		245 to 265°F	0.5	-80 to +20°C	B	-112 to +70°F	C
123 to 177°C	0.3			-38 to +50°C	0.5	-36 to +120°F	1
		270 to 290°F	0.5	-15 to +105°C	1	0 to 220°F	2
		295 to 315°F	0.5	-20 to +150°C	0.5	0 to 302°F	1
145 to 205°C	0.2	203 to 401°F	0.5	-5 to +300°C	1	20 to 580°F	2
145 to 205°C	0.4			-5 to +400°C	D	20 to 760°F	E
148 to 202°C	0.4			-2 to +300°C	F	30 to 580°F	G
		320 to 240°F	0.5	-2 to +400°C	H	30 to 760°F	I
18- to 250°C	A			10 to 200°C	1	50 to 392°F	2
173 to 227°C	0.4			15 to 70°C	1		
		345 to 365°F	0.5	25 to 80°C	1		
198 to 252°C	0.6			40 to 150°C	1	100 to 300°F	2
		395 to 415°F	0.5	77 to 260°C	1	170 to 500°F	1
		445 to 465°F	0.5	95 to 175°C	1	200 to 350°F	2
223 to 277°C	0.8			150 to 205°C	1		
248 to 302°C	1			Graduated in 2°C		Graduated in 5°F	
Graduated in 0.5°C		Graduated in 1°F		-6 to +400°C	J	20 to 760°F	K
-80 to +20°C	1			90 to 370°C	L	200 to 700°F	M
-37 to +21°C	0.2	-35 to +70°F	0.5				
-34 to +492°C	0.5	-30 to +120°F	0.5				
-20 to +50°C	0.5	-4 to +122°F	1				
-18 to +49°C	0.5	0 to 12°F	0.5				
-18 to +82°C	0.5	0-180°F	0.5				
-7 to +105°C	0.5	20 to 22°F	1				
-5 to +110°C	0.5	20 to 230°F	1				
-1 to +175°C	0.5	30 to 350°F	1				
		60 to 160°F	2				
16 to 82°C	0.5	60 to 180°F	0.5				
		75 to 175°F	2				
30 to 200°C	0.3	85 to 392°F	0.5				
95 to 255°C	1						
147 to 182°C	0.5						
155 to 170°C	0.5						
		300 to 400°F	2				
195 to 305°C	0.5	383 to 581°F	1				
195 to 305°C	1						
295 to 405°C	10.5	563 to 761°F	1				

A 0.4°C to 225°C; 0.6°C above 225°C**B** 1°C to -33°C; 2°C below -33°C**C** 2°F to -28°F; 4°F below -28°F**D** 1°C to 301°C; 1.5°C to 301°C**E** 2°F to 574°F; 3°F above 574°F**F** 0.5°C to 150°C; 1°C above 150°C**G** 1°F to 300°F; 2°F above 300°F**H** 1°C to 300°C; 1.5°C above 300°C**I** 2°F to 570°F; 3°F above 570°F**J** 2°C to 260°C; 4°C above 260°C**K** 5°F to 500°F; 7°F above 500°F**L** 1°C to 260°C; 2°C above 260°C**M** 2.5°F to 500°F; 3.5°F above 500°F

ATTACHMENT II**THERMOMETER VERIFICATION
ITM 909**

CERTIFIED THERMOMETER	
Manufacturer:	Model No.:
Type:	Date of Calibration:
Serial No.:	Graduation:

VERIFICATION OF THERMOMETER		
Manufacturer:	Model No.:	
Type:	Graduation:	
Serial No.:		
Is thermometer free of any apparent defects? (Yes or No)		
Certified Thermometer Reading	Thermometer Being Verified Reading	Correction Applied

Remarks _____

Verified By: _____

Date: _____
Next Due Date: _____